

# American POTATO JOURNAL

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***Official Organ of***  
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**NEW BRUNSWICK, NEW JERSEY**

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## PLANT FEEDING POTATO INSECT PESTS AND MEASURES FOR THEIR CONTROL<sup>1</sup>

DWIGHT M. DELONG<sup>2</sup>

Several insects feed from time to time and in different geographical areas upon potato vines, a few of which are important pests. For the purpose of the present treatment the six species, which are considered to be the major pests in the area east of the Rocky Mountains, are included in our studies. They are as follows:

The potato leafhopper — *Empoasca fabae* (Harris)  
The Colorado potato beetle — *Leptinotarsa decemlineata* (Say)  
The potato aphid — *Macrosiphum solanifolii* (Ashmead)  
The potato tuberworm — *Gnorimoschema operculella* (Zeller)  
The potato flea beetle — *Epitrix cucumeris* (Harris)  
The potato and tomato psyllid — *Paratrioza cockerelli* (Sulc)

Several other insects are important pests during a particular year or season.

<sup>1</sup>Accepted for publication February 20, 1952.

<sup>2</sup>Ohio State University, Columbus, Ohio.

### THE POTATO LEAFHOPPER (*Empoasca fabae*) Harris

The potato leafhopper (*Empoasca fabae*) was probably the most important insect pest of potatoes until the development of DDT in 1936. It is still a potential pest and when and if it develops a resistance to this and other related chemicals used for its control, it may again become a major pest. The leafhoppers feed by means of piercing sucking mouthparts which extract plant sap from the undersides of the leaves, veins, and stems and cause a conspicuous type of injury on potatoes known as "hopper burn."

This species of leafhopper uses its mouthparts for feeding and also for probing in the xylem and phloem tissues, thereby pushing portions of broken cells into the phloem vessels and plugging them. This prevents the translocation of manufactured materials from the leaf to the tubers and other parts of the plant and the overload of manufactured carbohydrates causes the death of the leaf cells.

This injury appears first as small brownish areas at the tip or terminal margins of the leaf between the veins. The leaf rapidly becomes brown toward the base, the veins remaining green for a longer time and the tips and margins of the leaves rolling or curling upward until the plant becomes brown and dry. Under field conditions this usually occurs early in the season when the tubers have just begun to develop (less than an inch in diameter) and as a result the entire yield is usually not worth harvesting.

The leafhopper hibernates as an adult and either migrates into northern areas from the Gulf or other southern states, or overwinters in the female stage only in more northern states. The males cannot be found in hibernating quarters and the females cannot be identified. In Ohio all attempts to overwinter both sexes have failed, but the early progeny of *E. fabae* upon certain deciduous trees, elm and others, has raised the question of female hibernation in northern areas. The eggs are deposited in the veins and midrib on the under surface of the leaf. Both the young and adults feed on the under surface by sucking mouth parts. Two or more generations occur each season.

### THE COLORADO POTATO BEETLE

The Colorado potato beetle is probably the best known and most easily recognized pest of potatoes because of its conspicuous color and size. It has been known in the eastern United States for nearly seventy-five years and is still a major pest in certain Atlantic coastal and southeastern states.

Both the reddish larvae and the yellow and black striped adults feed upon the foliage, devouring a large portion of leaf surface and terminal shoots in a short time and completely stripping the plants of leaves in many areas if not treated. This injury causes the death of the plants and prevents the development of the tubers, thus greatly reducing the yield.

The beetle stage occurs in the soil during the winter months. The eggs deposited upon the leaves give rise to fleshy larvae which become fully grown in two or three weeks and which later pupate in the soil. One or two generations occur per year depending upon the latitude of a particular area.

### THE POTATO APHID

In some areas and in certain seasons the potato aphid is a major pest. Epidemics are very sporadic. These aphids may be pink or green in color and occur in such large numbers that the entire terminal shoots are completely weighted down, the vines become curled, the leaves distorted, and the plants become brown and die. Many types of plants are attacked, but usually potato and tomato plantings produce the largest populations and suffer the greatest damage.

The overwintering eggs are found on rose and the young that hatch from these eggs feed on the rose early in the spring. They then develop rapidly and migrate to potatoes, where a new generation is developed every two to three weeks, the unmated females giving birth to young. Certain of these return to the rose and deposit eggs in the autumn.

The great danger to the plant is the fact that these aphids are vectors of several potato diseases, such as leaf roll, spindling tuber, mosaics, *etc.*, a topic covered by the previous speaker.

Because of the great variety of plants upon which the potato aphid can develop, clean cultivation in the field and the destruction of wild or stray rose bushes in the vicinity of the potato fields are important control measures for reducing the infestation.

### POTATO TUBER WORM

An important pest in the southern United States is the potato tuber worm, the larval stage of a moth. Although the worms attack tubers specifically, they also burrow in the stems and petioles and mine in the leaves. Potato tubers, both in the field and in storage, are riddled with dirty looking, silk-lined burrows made by the white or pinkish-white worms. Where temperatures are sufficiently warm the worms may continue to breed all winter in stored tubers. The moths emerge in the spring, escaping from storage houses and lay their eggs either on the under sides of leaves or upon exposed potato tubers. When leaves are infested, blotch mines are produced and the larvae work down into the stems from these mines. Large populations may be produced quickly since one generation may develop in about a month's time. The damage is most severe under conditions of high temperature and low rainfall.

Summer generations deposit their eggs upon the tubers in the field, the moths working down through cracks in the soil and depositing their eggs on exposed tubers at digging time.

In view of the nature of their work and the type of infestation, cultural control measures can be and should be used effectively. During the growing season, potatoes should be kept cultivated and deeply hilled. The wilting vines should be cut at harvest time and removed from the field to prevent the caterpillars from migrating from the vines to the tubers. The newly dug tubers should not be left exposed to the egg-laying moths during late afternoon or overnight. All tubers should be thoroughly removed from the soil and all culls destroyed.

When tubers are infested in storage they may be treated with methyl bromide at 2.5 pounds to 1000 cubic feet for at least three hours or with carbon bisulphide at 5 pounds to 1000 cubic feet for 48 hours.

When potatoes are placed in bags and transported, the bags should either be fumigated, or treated with a 1 per cent solution of DDT.

#### THE POTATO FLEA BEETLE (*Epitrix cucumeris*) HARRIS

The potato flea beetle attacks potatoes in two stages of its life cycle. Both the adult beetles feeding upon the leaves and the larvae feeding upon the tubers cause decided reductions in yields. The beetles feed upon both surfaces of the potato leaves, but usually on the under side where they eat small round holes through to the cuticle of the upper surface. The thin cuticle soon dries and falls out leaving the leaf riddled with small round holes. Severe feeding will cause the leaves to brown and drop. This loss of foliage retards growth and causes premature death of the plant and a consequent reduction in yield.

The larvae live in the soil and feed on the roots and developing tubers. Larvae feeding on the surface of the tubers cause roughened, pimply scars, whereas deeper feeding causes the formation of corky slivers about  $\frac{1}{4}$  inch long which extend into the tubers at right angles to the surface. Tuber injury is further increased by scab infection which enters through wounds made by the larvae.

The adult beetles overwinter in debris and other protected places. In the spring they appear early after hibernation, and feed upon the new potato plants. The females deposit eggs near the base of the potato plants and the hatching larvae migrate to and feed upon the roots, seed pieces, and developing tubers. After approximately two weeks of larval feeding the larvae pupate in earthen cells in the soil and soon emerge as beetles. The entire life cycle requires approximately from 4 to 6 weeks.

#### THE POTATO PSYLLID (*Paratrioza cockerelli*) SULC

In the Colorado potato growing areas and those of adjoining states the potato and tomato psyllid is undoubtedly the major pest of these crops. It produces on potatoes a diseased condition known as Psyllid yellows. This condition is recognized by the rolling of leaves at the base, and as the disease develops, the curling extends toward the tips. The leaves are hard and the plant remains in an inactive state of growth for a period of several weeks. No wilting occurs even when the plants become dry. In advanced stages the yellowing becomes more pronounced and the plant turns brown and dies.

Subterranean symptoms are also characteristic. A mass of small tubers may be attached close to the stem or a chain of small tubers is formed on a single stolon. The yields are quite low and a large percentage of small tubers is usually produced. The growth condition of the plant is so impaired that many fields are a complete loss, since the plants are unable to produce saleable tubers.

There is probably a secretion produced which is the causative agent of this disease. The physiological balance in the potato plant is upset and the condition becomes systemic. The phloem tissues are apparently broken down and the transportation of manufactured starches is either delayed or prevented.

## CONTROL MEASURES

In the various areas of the United States different potato insects of the groups discussed above may be of major importance. In the eastern coastal area of Virginia, for instance, the Colorado potato beetle and the flea beetles are of major importance and the aphids and leafhoppers assume a secondary role.

In this region DDT, either in spray or dust form, is usually recommended. For sprays, 2 pounds of wettable 50 per cent DDT powder or 1 quart of 25 per cent DDT emulsion in 100 gallons of water, is recommended per acre. If dusts are used a 3 to 5 per cent regular DDT dust or a 1 to 2 per cent impregnated DDT dust, at 30 to 35 pounds is recommended per acre. Usually 3 to 5 applications are made during a normal year. If the Colorado potato beetle larvae become large a 5 per cent regular DDT or a 2 per cent impregnated DDT dust is recommended.

As a rule the aphids are held in check by a DDT application, but if they become especially abundant, parathion is used either as a 1 per cent dust at the rate of 35 pounds per acre or 1 or 2 pounds of a 15 per cent parathion wettable powder per 100 gallons of water per acre.

In New York State flea beetles, leafhoppers, and aphids are the more important pests. DDT sprays and dust are usually recommended for their control and good control is ordinarily obtained. Five to eight applications are usually satisfactory. Parathion is recommended for aphid control when necessary.

In Colorado, the potato psyllid and the flea beetle are the most important problems. Here again DDT when properly used has given good control of both these pests and is of definite value against aphids and leafhoppers when these occur. According to Dr. List "Where a definite program with DDT is used, aphid control is fair but it will not clean up an infestation that has become heavy."

In North Dakota, DDT is also recommended for the control of aphids and other potato insects.

Although cultural and sanitary measures are very important for the control of the potato tuber worm as stated previously, when infestations occur in growing potatoes it may be controlled by the use of DDT either as a 5 per cent dust or a spray at the rate of 2 pounds of 50 per cent wettable in 100 gallons of water.

## LITERATURE CITED

1. Brooks, J. W. and Lauren D. Anderson. 1947. Toxicity tests of some new insecticides. *Jour. Econ. Ent.* 40: 220-228.
2. Davis, E. W. and B. J. Landis. 1951. Life history of the green peach aphid on peach and its relation to the aphid problem on potatoes in Washington. *Jour. Econ. Ent.* 44: 586-590.
3. Holmester, Richard N. and L. D. Anderson. 1948. Potato tuber moth control in Virginia. *Jour. Econ. Ent.* 41: 198-201.
4. Kulash, Walter M. 1947. Benzene hexachloride, DDT, and chlordane for Colorado potato beetle control. *Jour. Econ. Ent.* 40: 640-643.
5. ———. 1947. DDT and benzene hexachloride for potato flea beetle control. *Jour. Econ. Ent.* 40: 651-654.
6. Leiby, R. W. 1951. Recommendations for potato insect control for 1951. (Mimeographed Extension Circular), Cornell University, Ithaca, N. Y.

7. List, G. M. and W. C. Edmundson. 1946. Spraying and dusting potatoes with DDT and other materials. *Amer. Potato Jour.* 23: 347-352.
8. ———, J. H. Newton, J. L. Hoerner, W. J. Henderson, and Gordon T. Mickel. 1951. Pest control recommendations for 1950. Misc. Ser. Paper 449.
9. Lloyd, George W. 1951. Insecticide tests against the potato tuberworm. *Jour. Econ. Ent.* 44: 613-614.
10. Mitchener, A. V. 1950. A comparison of recent insecticides with calcium arsenate for control of potato insects. *Jour. Econ. Ent.* 43: 176-178.
11. Post, R. L., R. W. McCalley, and J. A. Munro. 1951. Insect control and yields from insecticidal plots — 1950. Rept. 159, Bimonthly Bull. 13: 150-153.
12. Sleesman, J. P. and J. D. Wilson. 1946. The effect of DDT on potato insect populations. *Proc. Ohio Veg. and Potato Growers' Assoc.* 31: 182-192.
13. Walker, Harry G. and Lauren D. Anderson. 1944. Fumigation with methyl bromide for potato tuber moth. *Jour. Econ. Ent.* 37: 539-540.
14. ——— and ———. 1944. Results of recent tests for control of truck crop insects. *Proc. Va. Acad. Sci.* 1943-1944.

VERTICILLIUM WILT AND SEED POTATO CERTIFICATION<sup>1,2</sup>BERNARD BARIBEAU<sup>3,4</sup>

Wilting and premature death of growing potato plants are frequently cause for concern on the part of the grower. When all the plants in a certain part of a field exhibit wilting and yellowing symptoms or death, it is evident that some unfavorable environmental factor such as excessive moisture, drought, unfavorable soil, shortage of nitrogen, heat, frost, or occasional lighting, is the cause. However, when wilted plants are scattered and are found growing at the side of apparently healthy plants, it is most probable that some infectious disease is the cause of wilting. There are several different parasitic diseases which produce wilting, yellowing and stunting of the plants. Among these are Verticillium wilt, Fusarium wilt, etc.

There has never been any attempt to differentiate between wilts in the seed potato inspection records in Canada and it is quite evident that, with regard to Verticillium wilt, this disease is not an important matter in Canada. Although Verticillium wilt never assumes epidemic form, it is found occasionally throughout Canada, being more prevalent in some provinces than in others. The inspection staff has done a great deal to familiarize the investigators and the growers with the type of symptoms induced by this disease, but due to the difficulties in identifying same, an accurate field estimate is impossible because the expression of symptoms may vary with the soil and climatic conditions and it is further complicated by the presence of early or late blight and also the diseased fields always show an increased percentage of infection later in the season when most field inspections are completed.

*DISTRIBUTION OF WILTS.*

Data have been compiled relating to the distribution of wilts in Canadian certified seed potatoes as it occurred in fields entered for certification during the past five years, as follows:

	1947	1948	1949	1950	1951
Total fields inspected	14,616	15,635	15,476	16,203	10,300
No. acres inspected	60,385	70,561	72,706	75,352	44,582
Fields rejected for wilt (1 per cent wilt and over)	104	38	45	130	2
Per cent field rejected for wilts	0.7	0.2	0.3	0.8	0.02

<sup>1</sup>Accepted for publication February 21, 1952.

<sup>2</sup>Contribution No. 92 — Division of Plant Protection, Science Service, Department of Agriculture, Ottawa, Canada.

<sup>3</sup>District Inspector in Charge, Seed Potato Certification Office, Post Office Building, Ste-Anne de la Pocatiere, P.Q.

<sup>4</sup>Division of Plant Protection, Science Service, Department of Agriculture, Ottawa, Canada.

These figures are taken from the seed potato inspection reports and indicate that the percentage of fields rejected is very low.

More wilt was reported in 1950 than in the immediately preceding years, due, it is thought to the dry weather, resulting in very evident symptoms. The rejection of very few fields in 1951 may be attributed to some extent to a late blight epidemic which has rendered the identification of wilts impossible.

### SYMPTOMS.

The symptoms of *Verticillium* wilt are very similar to those produced by *Fusarium* sp. The dying here and there of one or two stems in a hill or the entire plant commonly ascribed to mixture of varieties is usually caused by this disease. Attacked plants may wilt rather suddenly and die in a comparatively short time or they may show the effects slowly and die very gradually. Plants produced from infected tubers may be stunted from the beginning and die without reaching average size. Those taking the disease from neighboring plants or from soil show their first symptoms in the loss of bright green color and a tendency of the leaves to curl upward along the midrib, thus exposing their lower side. There may also be some tip burning. Such vines die prematurely, but the stalk remains upright, except for the tip which may droop. The lower leaves are affected first and droop after wilting until there is often only a cluster of green leaves at the tip. Longitudinal or cross sections of stem and pedicels of affected plants show the vascular ring to be reddish brown or black, the discoloration often extending from the base well into the top. Often a grayish mycelial growth, which distinguishes this disease from *Fusarium* wilt appears on the wilted plants at ground level.

The infection of *Verticillium* wilt extends into the tubers and causes a brownish to black discoloration in the region of the vascular ring (Xylem) starting at the stem end of the tubers. Discoloration of the vascular ring of the stems and tubers, undistinguishable from that caused by the wilt fungus, may be brought about by physiological conditions and cannot be relied on as a definite symptom of wilt. Since the appearance of bacterial ring rot, there was often on the Green Mountain variety a pinkish discoloration around the eyes (reddish eye) and lately on the Canso, Teton and other varieties, pink blotches may be noted on other parts of tubers from affected hills. This discoloration resembles late blight infection but it is more superficial and seems to be associated with this disease although caused by a bacterium.

### TRANSMISSION.

The organism causing *Verticillium* wilt commonly occurs in the soil and is carried over winter in the infected tubers. When infected seed tubers are planted they produce weak plants with low yields, whereas in other cases the plant may grow to mature size and then show the wilt symptoms which may result in the death of the plant or the production of infected tubers. Infection from the soil may occur either through the cut surface of the seed-piece, in which case the symptoms develop much the same as if an infected seed-piece had been planted, or infection may

take place through the roots which usually result in wilt symptoms later in the season and the production of infected tubers. Losses result from reduced stands, wilt and death of the plants and from internal discoloration of the harvested crop.

#### *TOLERANCE FOR WILTS.*

The Canadian certification tolerance for "Wilts" is two per cent at first inspection and one per cent at second inspection for certified seed grade; one per cent at first inspection and one half of one per cent at second inspection for Foundation-A grade. In the case of seed of the Foundation grade, the maximum tolerance is .1 of 1 per cent. At shipping inspection, the standard concerning stem-end browning and internal discoloration with penetration to  $\frac{1}{2}$  inch, the tolerance is 4 per cent. Since the tolerance for such stem-end or internally discolored tubers is low for certified seed, an entire lot may be thrown out of grade because of a relatively small amount of disease; thus the resultant financial loss is often greater than the loss in yield because of wilted plants.

#### *MEANS OF CONTROL.*

The control of wilts is very difficult inasmuch as the causal organisms are commonly present in the soil and may even occur in virgin soils.

The chief recommended means of control of Verticillium wilt are as follows: (1) plant tubers that are not diseased and use only certified seed; (2) avoid known infected soil and practice a long rotation where the disease has been encountered; (3) plant the less susceptible varieties; (4) clean cultivation to prevent the growth of susceptible weeds or cover cropping with cereals, grass or clover; (5) and rogue out diseased plants and those immediately adjacent to avoid diseased tubers. The most effective method of selecting seed stock free from wilt is by the use of tuber-unit seed plot. Wilted plants and their tubers should be removed. Tubers showing stem-end or internal discoloration exceeding penetration of more than  $\frac{1}{2}$  inch should not be used for seed, although there is no danger of transmitting the disease by the cutting knife.

In 1914, a seed potato certification program was started in North America. This marked the beginning of the seed potato industry. The quality of seed potatoes has improved greatly since that date. This improvement was made possible by the additional knowledge gained in methods of control of disease by tuber indexing, by the use of tuber-unit planting, by the growing of Foundation seed stock, by early harvesting and by the enforcement of more rigid standards by certification agencies.

The continuous improvement of seed-certification requirements is doing much to improve the quality of seed potatoes and to reduce greatly the losses from diseases. Therefore, the problem of successfully combating this disease, depends upon the seed potato inspection staffs to estimate the presence and severity of this trouble in the field despite environmental conditions which may modify or aggravate normal symptoms.

THE EFFECT OF HERBICIDES UPON POTATOES  
USED FOR CHIPPING<sup>1</sup>TOM EASTWOOD<sup>2, 3</sup>

In a cooperative experiment with the Pennsylvania State College at Camp Potato, Pennsylvania, during the growing season of 1951, some adverse effects of several herbicides were noted on the potatoes when they were processed into chips. The several herbicidal materials were applied as a delayed pre-emergence treatment on Rural Russet potatoes which were planted the first of June, 1951. A few plants were just coming through the soil surface when the applications were made on the 18th of June, 1951. Because of rainy weather, applications of the various treatments were delayed for three days.

*Materials and Procedures:*

The materials used and the concentrations applied are listed in table I with the specific gravity data for the tubers produced. All materials were applied in a volume rate of approximately 50 gallons per acre.

Two lots of these potatoes, which were dug on September 21, 1951, were given processing tests. The first lot was taken as freshly dug and were tested for chipping once a week for seven weeks, while held at a curing temperature of 70°F. The second lot was held in cool storage at 54°F. for six weeks before they were transferred to the curing storage conditions of 70°F. The potatoes in this lot were then given the same tests for a period of six weeks as were given the first lot. The data presented are the means of each lot for the total curing period varying from 6 to 7 weeks.

*Results:**Specific Gravity Effects:*

It was observed that the several materials caused a decrease in the specific gravity of the potatoes. Table I lists that data as secured for the two lots by the use of the National Potato Chip Institute potato hydrometer.

Significant reduction in the specific gravity of the potatoes was caused by the pre-emergence herbicidal treatments. This significance held for all treatments for each separate storage lot, but some significance was lost on an average basis for the two lots. No doubt the statistical analyses, which were done only with the lot means instead of all the individual means, caused this loss. It was not possible to use the split plot analyses because the two lots had different lengths of curing storage.

Although the specific gravity was reduced materially it was not decreased below an acceptable level suitable for good chipping. No significant difference occurred in the specific gravity between the two separate lots of potatoes.

<sup>1</sup>Accepted for publication, March 20, 1952.

<sup>2</sup>Professor J. Stanley Cobb of the Department of Agronomy, The Pennsylvania State College, State College, conducted this herbicide experiment. He kindly supplied us with some potatoes from these plots for our chip-processing tests.

<sup>3</sup>Wise Potato Chip Company, Berwick, Pa.

TABLE 1.—*Specific gravity of Rural Russet potatoes from plants which had received delayed pre-emergence herbicidal treatments.<sup>a</sup>*

Material	Amount/Acre	Mean Specific Gravity When Held at Curing Storage at 70° F. for Six to Seven Weeks		
		No Cool Storage	6 Weeks Cool Storage 54° F.	Average
CaCN <sub>2</sub>	1200 lbs.	1.0886**	1.0887**	1.0887**
CaCN <sub>2</sub>	800 lbs.	1.0884**	1.0892**	1.0888**
CMU	1 lb.	1.0903**	1.0903**	1.0903*
CMU	2 lbs.	1.0879**	1.0867**	1.0873**
C. H. 1	5 lbs.	1.0910*	1.0883**	1.0897**
C. H. 2	5 lbs.	1.0911*	1.0913**	1.0912
Na TCA	25 lbs.	1.0896**	1.0903**	1.0900*
Pre-emerge	2 gals.	1.0870**	1.0893**	1.0882**
S. G. (plus 1 pt. oil)	2 qts.	1.0903**	1.0912**	1.0908
Unt.	—	1.0924	1.0935	1.0930
*LSD (5 per cent)		0.0013	0.0014	0.0025
**LSD (1 per cent)		0.0018	0.0019	0.0031

<sup>a</sup>CaCN<sub>2</sub> (Cyanamid)

C M U (3-p-chlorophenyl-1-1-dimethylurea)

C H-1 (Crag Herbicide 1) Sodium 2,4-dichlorophenoxy ethyl sulfate

C H-2 (Crag Herbicide 2) Dichloral urea, 73 per cent WP

NaTCA (Sodium trichloroacetate) 90 per cent

Pre-emerge (Alkanolamine salt) (ethanol and isopropanol series) of dinitro-o-sec-butyl phenol, 53 per cent (equivalent 3 lbs. DNOSBP per gal.). Twice the usual quantity of this herbicide was used for this particular experiment.

S. G. (Sinox General) Dinitro-o-sec-butyl phenol, 50 per cent and Dinitro-o-sec-amyl phenol, 10 per cent (equivalent 5.1 lbs. per gal.)

Unt. (Untreated)

*Chip Color Effects:*

Fry tests were conducted using a vegetable oil as the frying medium at a temperature of 350° F. A grading system range of 1 to 5 was used, a grade of 1 representing good color, and grade 5, very poor color.

Although no significant changes in the color of the chips were detected, several treatments did cause the color to change, at least, beyond acceptable limits. Further, no significant differences for chip color were determined between the two separate lots.

*Taste Tests Effects:*

Small scale taste tests were performed upon the above processed chips with a semi-trained panel. A similar grading system as used for the chip color determinations was employed. As the grading system had only four units for the first lot of potatoes, those which received no cool storage, and five units for the second lot of potatoes, those which

received six weeks cool storage at 54°F., an average taste for both lots cannot be calculated. Experience with the first lot dictated a change to the five unit grading system which was more accurate and capable of distinguishing smaller differences in flavor. Table 3 presents the taste data obtained.

TABLE 2.—*Color of chips processed from Rural Russet potatoes from plants which had received delayed pre-emergence herbicidal treatments.*

Herbicides	Mean Chip Color When Held at Curing Storage of 70°F. for Six to Seven Weeks			
	Amount/Acre	No Cool Storage	6 Weeks Cool Storage 54°F.	Average
CaCN <sub>2</sub> .....	1200 lbs.	2.42 <sup>n</sup>	2.50 <sup>n</sup>	2.46 <sup>n</sup>
CaCN <sub>2</sub> .....	800 lbs.	2.42 <sup>n</sup>	2.17	2.30
CMU .....	1 lb.	2.42 <sup>n</sup>	2.50 <sup>n</sup>	2.46 <sup>n</sup>
CMU .....	2 lbs.	2.28	2.17	2.23
C. H. 1 .....	5 lbs.	1.71	2.00	1.86
C. H. 2 .....	5 lbs.	2.00	2.17	2.09
Na TCA .....	25 lbs.	2.00	1.83	1.92
Pre-emerge. ....	2 gals.	2.14	2.33	2.24
S. G. (plus 1 pt. oil) ..	2 qts.	1.85	2.00	1.93
Unt. ....	—	2.00	2.17	2.09
<sup>n</sup> —beyond acceptable limit of — .....		2.40	2.43	2.38
LSD (5 per cent) .....		0.46	0.49	0.43
LSD (1 per cent) .....		0.61	0.66	0.53

An effect upon the flavor of potato chips was detected as a result of using some of these herbicides as a delayed pre-emergence treatment. Although the data are a bit erratic, in comparing the two lots, a high degree of significance was observed within the separate lots.

#### *Other Effects:*

Reducing sugar tests with the picric acid method indicated that no effect occurred as a result of the herbicidal applications. However, the average reducing sugar levels were highly significantly greater in the first lot of potatoes as compared to the second lot.

The keeping quality or tuber condition during the curing storage was found to be similar for all the treatments and comparable to the untreated potatoes. But, the keeping quality had been highly significantly reduced as a result of the six weeks cool storage, that is, the latter lot did not keep as well as the first lot. However, the tuber condition of both lots was commercially acceptable.

TABLE 3.—*Taste of chips processed from Rural Russet potatoes from plants which had received delayed pre-emergence herbicidal treatments.*

Herbicides		Mean Chip Taste When Held at Curing Storage of 70° F. for Six to Seven Weeks	
Material	Amount/Acre	No Cool Storage	6 Weeks Cool Storage 54° F.
CaCN <sub>2</sub>	1200 lbs.	2.66n**	2.63
CaCN <sub>2</sub>	800 lbs.	2.66n**	3.13n*
CMU	1 lb.	1.66	3.75n**
CMU	2 lbs.	2.00*	4.13n**
C. H. 1	5 lbs.	1.66	3.38n*
C. H. 2	5 lbs.	2.77n**	3.63n**
Na TCA	25 lbs.	3.00n**	3.25n*
Pre-emerge.	2 gals.	2.66n**	2.88
S. G. (plus 1 pt. oil)	2 qts.	1.66	2.75
Unt.	—	1.33	1.75
n—beyond acceptable limits of		2.53	3.13
*LSD (5 per cent)		0.60	1.20
**LSD (1 per cent)		0.79	1.71

The percentage loss in curing storage was not enhanced by the use of the herbicidal materials. The losses were significantly greater for the first lot, as expected but they were within acceptable ranges.

#### Discussion:

The effect of these herbicides upon reduction of the specific gravity or the dry matter content of the potatoes was interesting to observe. It appears possible that the pre-emergence treatments caused a stunting effect of the growth of the potato plants well beyond that visible to the eye. These plants suffered the usual temporary set-back for a few weeks following the application of the herbicides. But, in time the plants again appeared relatively normal not only in size but also in general appearance of the tops. Although yield data were not taken at the completion of the experiment, general observation at harvest showed no great differences in either the total yield or percentage of No. 1 tubers. It may be possible that the general efficiency of the treated plants was reduced, at least in relation to the photosynthetic activity and the resultant accumulation of starch in the tubers.

Apparently only two of the compounds caused any off-color in the processed chips; namely, the Cyanamid and the CMU. Since materials, other than reducing sugars, have been known to cause dark colorations in potato chips, the effect of the Cyanamid is of particular interest. Smith and Shallenberger\*(1) have shown that certain soluble organic nitrogen

compounds, such as some amino acids, may combine with reducing sugars in the potato tuber to form dark-colored compounds. These observations agreed with previous results obtained in our laboratory. It is quite possible that the soluble organic nitrogen fraction content of the tubers from plants that were liberally fertilized with Cyanamid would reach a relatively high level. Hence with a greater than normal level of these fractions the chances of recurrence of the above reactions would be increased.

The most striking effect observed was the development of off-flavors in the chips prepared from the tubers from herbicide-treated plots. These off-flavors were quite pronounced, but were not distinctive in relation to type of off-flavor or to the kind of compound causing the off-flavor. Only one of the herbicides used showed no effect upon the flavor of the chips; namely, the Sinox General. Several of the other materials consistently gave off-flavor in both lots of potatoes, whereas in some of them it occurred only in one or two lots. There was no trend as to whether or not the use of a cool storage had any effect upon the flavorizing effect of the herbicide upon the chips. Probably if the more exact grading schedule for the second lot had been used for the first lot, definite flavor effects would have been detected in both lots in all treated potatoes with the exception of the untreated, and those treated with Sinox General.

#### *Conclusions:*

At least under the conditions of this experiment the use of certain herbicides as a delayed pre-emergence application on potatoes caused some adverse effects both upon the potato tuber and upon the processed chip. The specific gravity of tubers from treated plants was significantly reduced. To a limited extent poor color of the chips was related to the use of a herbicide compound. Finally, an additional adverse effect upon the processed potato chip was the presence of off-flavors.

The observations reported here should stimulate work in the study of the effect of the various herbicides used both commercially and experimentally on potatoes upon the eating quality of the tubers, and in particular upon the eating quality of the processed potatoes such as potato chips. In other words the internal quality of the treated potatoes is an important concern as well as the efficacy of the herbicide as a weed control agent and its effect upon the yield of marketable tubers.

#### LITERATURE CITED

- \*1. Smith, Ora and Shallenberger, R. S. Factors affecting color of potato chips. Cornell University, Annual Meeting, 1951, The Potato Association of America.

EXPERIMENTS WITH COLCHICINE TREATMENT  
OF POTATOES IN ALASKA<sup>1</sup>BASIL M. BENSIN<sup>2</sup>

Experiments with colchicine treatment of potatoes were originated by the author at Alaska Agricultural Experiment Station, College, Alaska, as an Agronomist, conducting experimental work of Agronomy and Horticulture in 1947-1949. This station is located near Fairbanks, 64°52' N latitude on the northern limits of Agriculture in the main land of Alaska. The frostless period in Fairbanks averages 89 days. However these days are very long, during the months of June and July — over 20 hours. The total number of sunshine hours during the months of June, July, and August are 839 or 9 hours daily. The average temperature is 57.7°F. with the total number of degree days being 2382 (Base 32°F.) and 727 (Base 50°F.) The general response of garden plants to these long days is luxurious foliage particularly in cabbage, which often weighs 30 pounds a head. Likewise potatoes have well-developed vines but very flat tubers because of the cool soil. This is particularly true in the Fairbanks area, which is located at the perma-frost zone. (Fig. 1.)

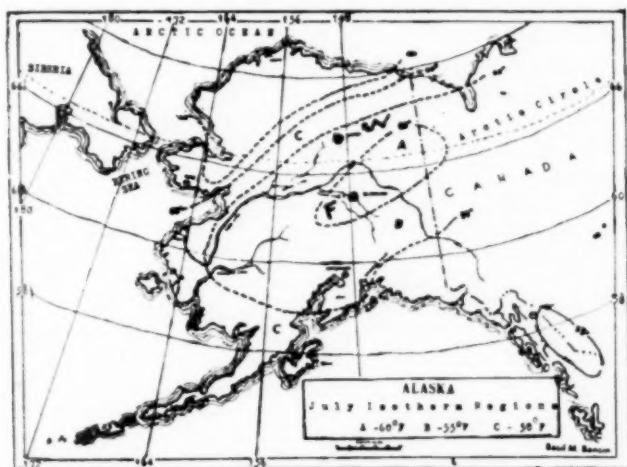


Fig. 1.—July isotherm regions of Alaska. F—Fairbanks located at 60°F. isotherm. W—Wiseman located at 55°F. isotherm. (These areas might be considered as northern limits of potato growing.)

The aim of the colchicine treatment of various field crop plants was to discover whether or not very well established cytological changes, indicating doubling of chromosomes (Johnstone, Stevenson, Stelzner), would cause morphological changes of crop plants, particularly potatoes, and also if these changes would affect the maturity and production ability, under our sub-arctic environmental conditions.

<sup>1</sup>Accepted for publication January 6, 1952.

<sup>2</sup>College, Alaska.

The potato varieties for the colchicine treatments were selected as follows:

1. White Bliss introduced into Alaska about 30 years ago, very well adapted at present.
2. Arctic Seedling-local selection of White Bliss grown at Wiseman, Alaska, above the Arctic Circle ( $67^{\circ} 26' N$  latitude).
3. Swiss, German variety introduced 15 years ago by Frank Betschard, farmer from Switzerland, also a well adapted variety.
4. Katahdin, introduced 15 years ago: also well adapted.
5. Sequoia, introduced from Victoria, British Columbia, in 1945, indicating frost resistance for early frosts.
6. White Rose, introduced from California in 1946: not adapted as yet.
7. Teton, from Wyoming, introduced in 1947, as a Ring Rot-resistant variety.

*Colchicine-Treatment Procedure.* Colchicine tincture (extract from the seeds of *Colchicum autumnale*) 4 per cent solution (0.04 gm. per 100 cc of tincture) has been used. Thirty drops or 2cc of this tincture were added to 2000cc (half gallon) of water for the treatment of potato tubers, in which they were treated for 35 minutes.

*Potato Culture.* Potato seed are usually sprouted before planting. They are then planted between May 15th and June 5th, emerging normally in 21-23 days. Hilling is used after the beginning of the blossoming period. The potato vines remain green until the first frost. There is no variety that reaches maturity, that is, if indicated by dried vines. Only a few varieties produce seeds-potato balls, as Katahdin and Teton. Fertilizer 5-10-10, at the rate of 500 to 1000 pounds per acre is commonly used. All potatoes are usually harvested one week after the first killing frost.

Field experiments with treated and untreated tubers of the same variety were arranged on the experimental plots of varietal tests. Seed-cut tubers were planted in rows 36 inches apart with hills approximately 18 inches. The first treatment of potato tubers with colchicine was made in 1947. At harvest time a striking effect was noted in the increased size and irregular shape of tubers that developed in the hills from the treated tubers, a distinct departure from normal. The variety, White Bliss, has been used for this test.

*1948 Experiment.* In 1948 these abnormally shaped potatoes were cut and planted. An application of fertilizer 5-10-10, was applied at the same rate as was used for the varietal test, 500 pounds per acre. These potatoes were planted on June 9th and harvested August 28th. The average yield from the replicated rows was 13 per cent higher than from the untreated rows. A closer analysis of the two rows, the first with 20 hills of treated seeds, the second with 14 hills of untreated seed, indicated a striking difference, particularly in the size and weight of the graded tubers.

The potatoes from treated and untreated seed were divided into three classes: small, medium and large. Each class showed an increase in weight averaging 54 per cent for the treated seed as compared with

the untreated, whereas the number of tubers remained about the same in each, with a slight increase in treated of 1.03 per cent, as shown in the table below.

TABLE 1.—*Analysis of two rows of treated versus untreated potatoes.*

A. Seed potato tubers treated before planting. (20 hills in 1948)

	Size of Tubers	Number of Tubers	Total Weight Grams	Average Weight per Tuber
Large	(150-280 grams)	32	6,340	198.1
Medium	( 65-150 " )	72	7,400	102.8
Small	( 23- 65 " )	24	1,075	44.8
Total		128	14,815	115.7

B. Seed potato tubers not treated. (14 hills in 1948)

	Size of Tubers	Number of Tubers	Total Weight Grams	Average Weight per Tuber
Large	(58-165 grams)	52	5,240	100.8
Medium	(30- 58 " )	29	1,425	49.1
Small	(13- 30 " )	7	115	15.4
Total		88	6,780	77.0

Variety, White Bliss, 1948, College, Alaska.

*Experiments of 1949.* Experiments with the variety of White Bliss treated with colchicine in 1947 were continued. In addition to the White Bliss, several other varieties were treated in the spring just before planting. These varieties were Arctic Seedling, Swiss, Sequoia, Katahdin, White Rose, and Teton. All were planted on June 1st. Climatic conditions were most unfavorable for the normal potato growth because the month of June was very cool and wet. As a result, the emergence of potatoes was retarded until the first of July, and at that time an uneven stand appeared. Likewise the blossoming period was delayed and only two varieties, Teton and Katahdin, showed developed seedballs. Following the colchicine treatments the foliage and stem ramifications were evidently affected in the Katahdin and White Bliss varieties. The leaf area of the Katahdin variety was conspicuously larger, than were those of the untreated. Colchicine-treated White Bliss indicated a somewhat larger number of branches, whereas the Arctic Seedling, which is acclimated White Bliss, showed little difference either in foliage or stem branching.

Tubers of all treated varieties were distinctly abnormal in shape with a large percentage of knobby and irregular tubers with deep eyes, and a general outline, that presented a marked departure from the normal variety type, as shown in figure 2—(1), (2), (3).

Tubers of the colchicine-treated Katahdin were abnormally elongated

and flattened, but were quite smooth and knobless. Likewise the variety Sequoia yielded smooth knobless tubers as shown in figure 2—(+).

The results of this experiment, indicating yield of treated and untreated hills, are shown in table 2.

TABLE 2.—*Experiment with colchicine treatment of potato tubers in 1949, College, Alaska.*

Variety	Number of Hills	Total Weight Pounds	Weight per Hill	Bushels per A.	Difference Bus.
Arctic Seedling					
Treated	16	79.8	4.9	395	
Untreated	16	30.6	2.3	185.5	209.5
White Bliss					
Treated	44	136.3	3.09	249.2	
Untreated	19	21.2	1.1	88.7	160.5
Swiss					
Treated	20	67	3.3	266.2	
Untreated	12	25.7	2.1	169.4	96.8
White Rose					
Treated in 1947	20	69.5	2.9	234.0	
Teton					
Treated	25	64.5	2.5	201.6	
Untreated	22	37.8	1.7	137.1	64.5
Katahdin					
Treated	23	75.5	3.2	258.0	
Untreated	30	52.6	1.7	137.1	120.9
Average—Treated			3.6	267.3	
Average—Untreated			1.8	143.5	
Difference			+2.2	+123.8	46.7

#### SUMMARY

1. Colchicine treatment of potatoes in Alaska indicates the possibility of increasing yields.
2. Cytological changes of the potato plants have an effect upon morphological features, both foliage and tubers.
3. Shape of tubers indicates a conspicuous departure from normal, being very irregular, and of an unmarketable type.
4. Morphological features of stem, branches and leaves indicate a general tendency of increasing the leaf area, but not in all varieties.
5. The morphological modifications described could result from a specific response of the treated plants to sub-arctic environment.
6. Economic significance of increased yields could be considered very essential for industrial uses of potatoes, as dehydrated feeds, starch and alcohol industries needed in Alaska.
7. Colchicine treatment does not hasten the maturity of the plants, but rather retards it. For instance, as in the case of spring wheat, colchicine treatment retards the maturity for a period of more than 10 days.

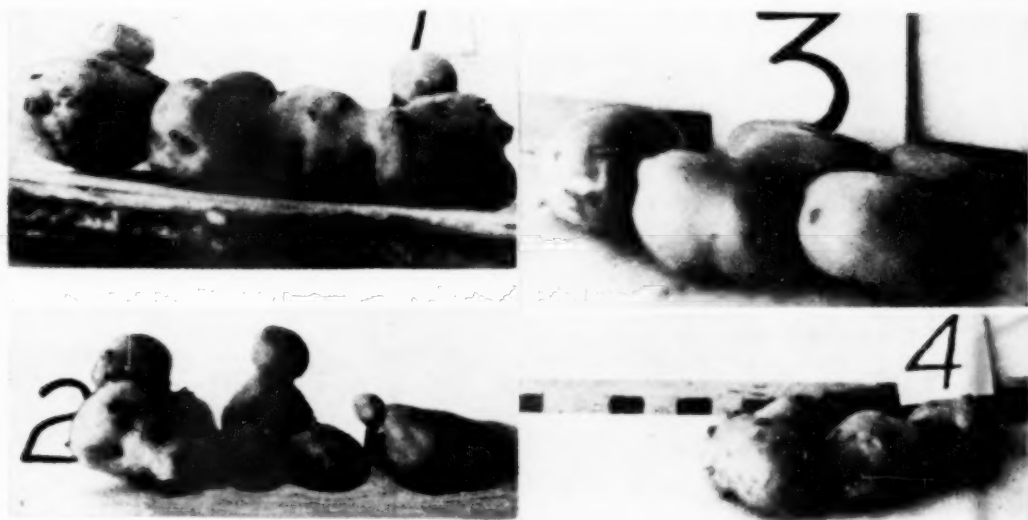


Fig. 2—(1) — Tubers treated with colchicine. (Variety, Arctic Seedling.)

Fig. 2—(2) — Tubers treated with colchicine. (Variety, Swiss.)

Fig. 2—(3) — Tubers treated with colchicine, 1949. (Variety, Katahdin.)

Fig. 2—(4) — Tubers treated with colchicine, 1949. (Variety, Sequoia.)

#### LITERATURE CITED

1. Baker, R. E. 1943. Induced polyploid periclinal chimeras in *Solanum tuberosum*. Amer. Jour. of Bot. 30: 187-194.
2. Calvet, R. P. and M. M. de Zulueta. 1946. Statistical methods for comparing a larger number of varieties. Bol. Inst. Nac. Invest. Agron. Madr. No. 14: 29-62.
3. Campbell, J. C. 1940. Potatoes. N. J. Agr. Exp. Sta'n. Report. (P. 71)
4. Johnstone, F. E. 1939. Chromosome doubling in potatoes induced by colchicine treatment. Amer. Potato Jour. 16: 288-304.
5. Jones, A. E. 1946. A useful method for the routine estimation of dispersion from large samples. Biometrika 33: 274-282.
6. Stelzner, G. 1941. Colchicine — induced polyploidy in *Solanum tuberosum*. Der Zuchter 13: 121-128.
7. Stevenson, F. J. 1943. Potato Breeding Genetics, and Cytology: Review of Literature 267-279. Colchicine experiments. Amer. Potato Jour. 20: 276-278, 196.
8. ———. 1947. Plant Breeding Abstracts. 17: 399, 543.

SOME SUGGESTIONS FOR INDEXING POTATO TUBERS<sup>1</sup>AVERY E. RICH<sup>2, 3</sup>

## INTRODUCTION

In the course of experimental work during the past several years, the writer has been faced with the problem of determining the virus content of large numbers of potato tubers. Tuber indexing has been used widely for many years by numerous workers, and certain improvements in technique have been developed by each one to serve his needs. The purpose of this short paper is to record the improvements found useful by the writer, which he hopes will be helpful to others. It will also serve the purpose of answering the many inquiries received from growers, Extension workers and certification officials regarding the detailed procedure of tuber indexing.

Potato tuber indexing consists of the removal of one eye from a tuber, planting it, and observing the condition of the plant growing from it. The assumption is made that any virus disease present in the tuber will be transmitted by all of the eyes of that tuber.

## NUMBERING

It is necessary somehow to identify each tuber with the eye removed from it. This is usually done by numbering each tuber and by assigning a corresponding number to the eye removed from it. Experience has shown that a ball-point pen works very well for this numbering. The numbers remain legible after washing or even after several weeks' burial in the soil. However, they tend to fade if exposed to direct sunlight for a long period. Inexpensive ball-point pens, with replaceable refill cartridges are available. A cartridge will usually last for about 500 tubers.

## EYE REMOVAL

A simple kitchen gadget sometimes called a salad baller (Fig. 1) has proved satisfactory for the removal of the eyes from the tubers. This idea is not original with the writer, but it seems worthy of passing on to others. This removes a piece of the tuber about  $\frac{1}{2}$  ounce in size and hemispherical in shape.

## BREAKING DORMANCY

Potato tubers are normally dormant for several months after harvest. Therefore, in order to index tubers as soon as possible after harvest, it

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<sup>3</sup>The writer gratefully acknowledges the assistance and helpful suggestions given him by Dr. Seth Barton Locke, Associate Plant Pathologist, State College of Washington.



Fig. 1.—Salad baller used to remove the eyes from the tubers.

is necessary to treat the index pieces to hasten sprouting. For this purpose, a number of chemicals were tested alone and in various combinations. The most consistent results were obtained using the following method:

Place the index pieces in a tight glass container such as a quart fruit jar. Pour over them a solution of ethylene chlorhydrin prepared by diluting 30 cc. of this chemical with 970 cc. of water. Pour the solution off, place a crumpled paper towel in the mouth of the jar, screw the cover on, and invert. After 16 hours, remove the cover and paper towel. The solution may be used for a dozen or more jars consecutively before discarding. It should be kept tightly covered when not in use.

#### SUBERIZING

The eye pieces may be planted immediately after treatment for breaking dormancy. However, it is a worthwhile precaution to place them in moist peat moss or vermiculite for 2 or 3 days, to favor suberization. If this is not practical, a very light dusting of the cut surface with Spergon before planting will protect them from decay. However, an excessive amount of Spergon may cause injury. Ferbam, ziram or zineb may also be used to dust the cut surface, but excessive amounts should be avoided.

#### PLANTING

The suberized or dusted index pieces may be planted in benches or deep flats as close together as 4 inches in each direction. They should be arranged in numerical order for convenience of identification. An excess of nitrogen in the soil should be avoided as it sometimes masks leafroll symptoms, especially when light conditions are poor. If index pieces are covered with only a shallow layer of soil, *Rhizoctonia* is not apt to be a problem.

#### GROWING CONDITIONS

A temperature in the vicinity of 70°F. is maintained until the plants are several inches tall, and then it is dropped to approximately 60° until symptoms develop. During short winter days, fluorescent lights have proved very helpful in obtaining good growth.

Disease readings can usually be made when plants are about 6 inches tall. If plants are removed as soon as readings are made, it gives the smaller ones more room and helps control insects. Several plantings are possible in the same greenhouse during the winter.

A SUCCESSFUL FOUNDATION SEED FARM<sup>1</sup>PAUL J. EASTMAN<sup>2</sup>

Maine's history in the potato business has been beset with numerous problems, any one of which could have practically wiped out the industry had not a solution been found. With a staff of some of the best potato research men in the country, Maine has taken problems in stride, found their causes and worked out practical means for their solution. Leafroll "had us on the ropes" in 1936 and by the use of isolated seed plots, early harvest, and Florida testing we managed to get it under control. DDT, of course, came along with a helping hand in 1943. Other new insecticides now being developed will doubtless overshadow DDT. In the early 40's bacterial ring-rot seemed to be getting the better of us when more than 50 per cent of our farms showed some degree of infection. Through sanitation, foundation growers and other allied practices bacterial ring-rot has been practically wiped out. A recent survey showed that only about 7 per cent of the farms showed any infection at all and these were mostly trace amounts.

Experience with these and many other diseases over the years has led us into a very definite foundation plan. This plan was started as a cooperative venture with selected growers, and State crews, doing the field work. Progress was achieved under this program but experience taught us that we needed a farm of our own where we could carry out all the known methods of disease control and seed improvement regardless of cost. We needed this farm as a constant source of super-foundation seed where, at premium prices, a grower could get small quantities of seed to renew his stocks continuously and if necessary replace his seed. To fulfill this need the Maine Legislature in 1947 appropriated \$100,000. This money was to be used to purchase and operate a seed farm. Provisions were made to repay this money, if possible, over a ten-year period. This fund was under the supervision of the Maine Seed Potato Board, a group of outstanding seed growers including the Commissioner of Agriculture as *ex-officio* chairman. This Board, with Mr. Wesley Porter as program director, decided upon a farm in December of 1947 and the purchase was made. The farm, located in the town of Masardis, was chosen because of isolation and because the quality of the potatoes then in storage at that farm was the best available. With the potatoes on this farm plus the small lots which the Board had in its possession we were in business.

Available with this farm were greenhouse facilities at Presque Isle to do index work on all varieties. This greenhouse was provided by the Potato Tax, a self-imposed industry tax for research and advertising. With the farm, the greenhouse and experienced workers, we were well fitted to do a job for the industry.

The prime consideration in operating the new farm was to keep it free from bacterial ring-rot. To our knowledge this disease had never been found on the farm and the future success of our venture depended, and still does, on keeping this disease off the farm. Each variety is handled

<sup>1</sup>Accepted for publication April 14, 1952.

<sup>2</sup>Assistant Chief, Division Plant Industry, Maine Department of Agriculture, Augusta, Me.

as a separate entity, with all precautions being taken to prevent the possibility of spreading any disease from one variety to another. In other words, if we should find bacterial ring-rot in one variety we would not be forced to assume it was in all varieties.

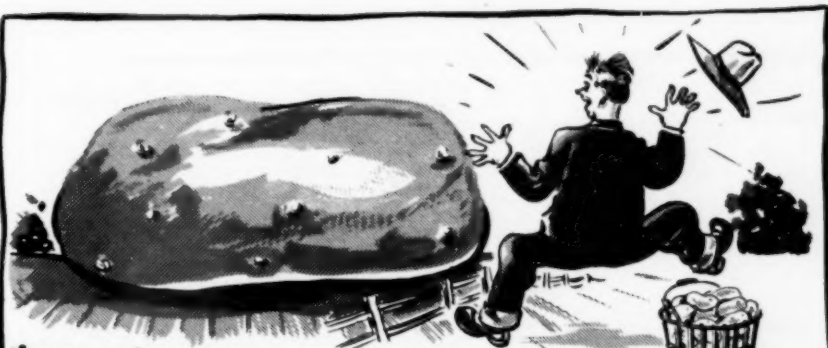
As bacterial ring-rot has become pushed slightly into the background in importance, our emphasis has swung to latent mosaic. In all varieties where clean material is available we have built up latent-free lots of seed through index work. In varieties where no latent-free material is available we have built up selections which carry the less virulent strains. Inoculation of new varieties with a weak strain of latent has been tried and found successful in some cases. At first, seed growers were a bit reluctant to believe our claims about latent free Katahdins. However, as these lots have become distributed and tried, more and more growers can see the difference and want some of this seed. We have proved to our own satisfaction that our foundation growers will gladly pay a premium for the type of seed we are growing and thus make the whole program a success.

During the four years we have operated the farm we have distributed approximately 150,000 bushels of improved seed to our seed growers. This seed has gone, in many cases, to growers who enter it in our Foundation Program. Through this service the seed is increased under supervision for another year and is then Florida-tested and passed on to certified growers.

At the present time we have on the farm Kennebec, Katahdin, Sebago, Chippewa, Green Mountain, Mohawk, Teton, Cobbler, Pungo, Cherokee and several numbered seedlings. Counting the different selections and different varieties there are more than 40 separate lots of seed. This amount of segregation involves a terrific amount of extra planning and labor which could never be done by an individual grower.

During the summer of 1951 about 150 new hill selections were made from six varieties. These are in addition to numerous hill selections which were made several years ago and are now being increased and further selected. Under our present plan we are indexing about 10,000 tubers each winter. From these indexed lots we can build, in three or four years, quantities large enough for distribution to foundation growers. We have found it possible to have only trace amounts of Virus X or latent mosaic in Katahdins after being increased four years following indexing.

As new varieties are developed we are ready with the machinery to increase and distribute them. We also have the facilities and the trained workers to apply whatever control measures may become necessary with the development of new diseases or problems.



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# THEY BOTH **Belong!**

Just as they both belong for efficiency and economy in operation, so do minerals and fertilizers belong in your soil if optimum crop production is to be achieved. Soil starving for minerals cannot produce healthy, abundant crops. Just as minerals are essential to the health of the human body, so are they essential to the health of your soil. Soil poor

in minerals cannot produce crops rich in vitamins. ES-MIN-EL contains the essential mineral elements of Zinc, Copper, Manganese, Iron, Boron and Magnesium — all essential to healthy, productive soil. Minerals are essential — ES-MIN-EL contains the essential minerals — Mineralize with ES-MIN-EL now!

## ES-MIN-EL

Essential

Mineral

Elements

### SOIL APPLICATION

ES-MIN-EL is now available in spray or dust form. If you haven't mineralized your soil you can feed these essential minerals to your plants through the leaves and stems — ES-MIN-EL spray or dust is a neutral form of Copper, Manganese and Zinc.



### REQUEST

that your local fertilizer dealer furnish you a completely mineralized fertilizer containing the essential mineral elements!



### Free Booklet

Send card or letter to Tennessee Corp., Grant Building, Atlanta, Georgia or Lockland, Ohio.

## TENNESSEE

Atlanta, Georgia



TENNESSEE CORPORATION

## CORPORATION

Lockland, Ohio



# MAN!

## That's the Way to Dig Potatoes!



Just look at the job that John Deere Double Level-Bed Digger is doing! No wonder so many leading growers are praising this modern two-row digger.

The pictures were taken on the farm of LaVern and Warren West, near Sarona, Wisconsin, while a 500-bushel-per-acre crop of Triumphs was being harvested. Both brothers state they have seen a lot

of diggers, but this John Deere has everything beat. Warren's comment was: "Picking up potatoes behind this digger is just like picking 'em off the table."

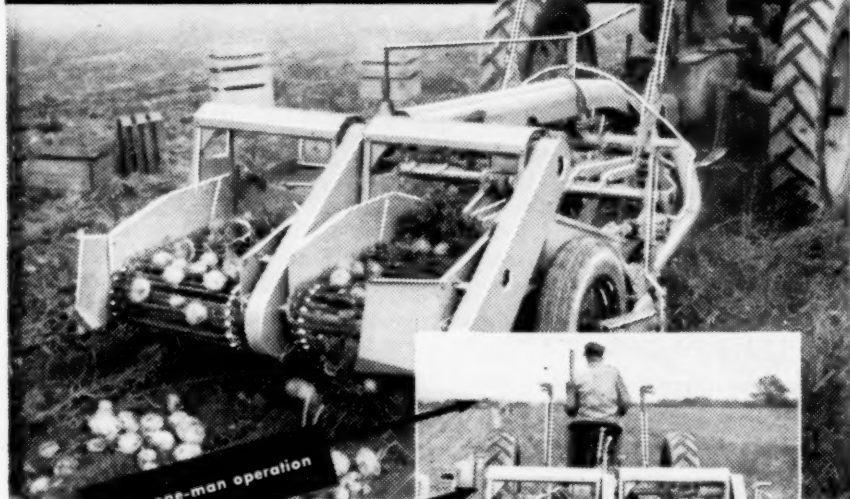
Full information on the complete line of Level-Bed Diggers—one- and two-row—can be obtained from your John Deere dealer or by writing to John Deere, Moline, Illinois, for free literature.



### JOHN DEERE DIGGERS

University Microfilms  
313 North 1st St  
Ann Arbor Michigan

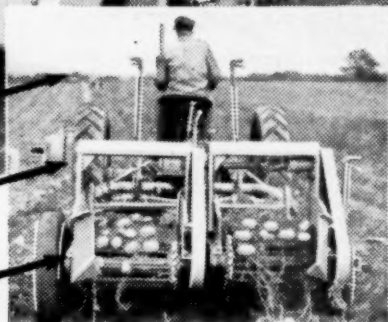
## Field Tests Prove You Get More Grade A Potatoes with IRON AGE DIGGERS



Easy one-man operation

Hydraulic lift controlled  
from tractor seat

Heat-treated steel chain  
lasts 50% longer



**F**IELD TESTS PROVE one man and the new continuous elevator Farquhar Iron Age Digger get more unbruised potatoes per acre at less cost! These tested Diggers are rugged one-man machines. Sturdy one-piece frame holds digger square, with no distortion . . . adjustable discharge shortens drop of potatoes to ground. One and two row models operate in any soil, up or down hill, are built for hard work at conventional tractor speeds. See them at your Farquhar Iron

Age Dealer's or write for information to:  
**A. B. FARQUHAR CO., Farm Equipment**  
Div., 3401 Duke St., York, Pennsylvania.

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